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By

L. SCOTT

&

R. G. KLEIN

Cape Town Kaapstad

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By

LOUIS SCOTT
Institute for Environmental Sciences,
University of the Orange Free State

&

RICHARD G. KLEIN
Department of Anthropology, University of Chicago

(With 3 figures and 2 tables)

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ABSTRACT

Late Holocene sands fringing Deelpan, Western Orange Free State, have yielded a sample of bones derived from steenbok, springbok, black wildebeest, blesbok, quagga or Burchell's zebra, caracal or serval, slender mongoose, clawless otter, black-backed jackal, and eagle or hawk, as well as coprolites of a hyena. The composition of the fauna is in keeping with pollen evidence that highveld vegetation prevailed at the time the bones accumulated. The absence of artefacts and porcupine gnaw marks, in combination with the hyena coprolites and two bones almost certainly damaged by hyena teeth, indicate that hyenas were responsible for the bone accumulation. Like other hyena-accumulated samples, the Deelpan one differs from human (archaeological) samples in the relatively high number of carnivore individuals represented and in the tendency for the ratio of postcranial to cranial bones to increase with the size of the species involved.

CONTENTS

INTRODUCTION

In the course of a multidisciplinary investigation into the history and origin of pans in the Orange Free State, Scott recovered an assemblage of bones from unconsolidated sandy deposits on the eastern margin of Deelpan (Honing Kopje Pan) (approximately 29°11′S 25°45′E), between Bloemfontein and Petrusburg (Fig. 1). Artefacts were absent, and nine associated coprolites, together with damage marks on two of the bones, point to hyenas as the bone collectors. In this brief report, Scott describes the setting and sedimentary

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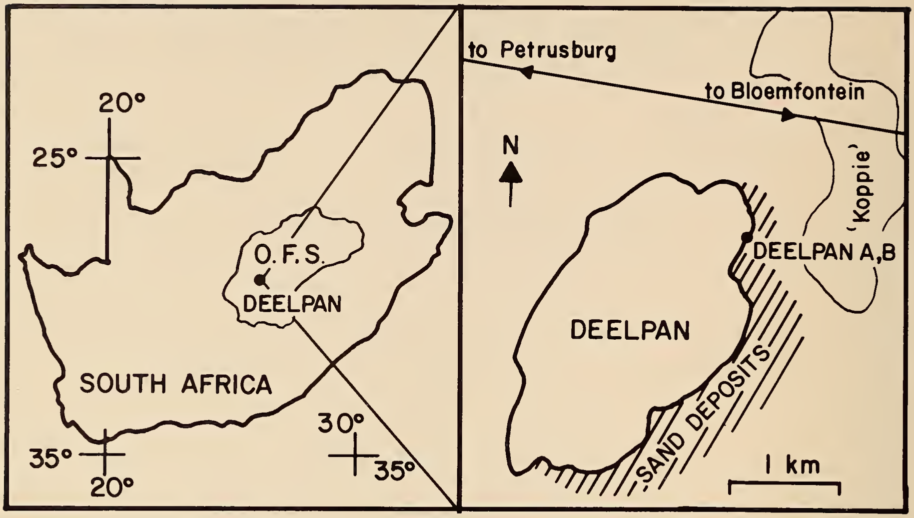

Fig. 1. *Left:* The location of the Deelpan fossil site within South Africa. *Right:* A schematic plan of Deelpan, showing the distribution of the sandy deposits on its southern and eastern margins and the points (Deelpan A and B) where bones were recovered.

context of the bone assemblage, while Klein discusses its implications for distinguishing hyena bone accumulations from human (archaeological) ones. In a future paper, K. W. Butzer (University of Chicago) will analyse a suite of sediment samples from the site, with the goal of elucidating its climatic and environmental history.

SETTING

Deelpan is typical of the numerous pans or playas that dot the plains of the western Orange Free State (De Bruiyn 1971, 1972; Le Roux 1978). The pans are thought to result from the interaction of bedrock geology, slope, salt concentration, chemical weathering, seasonal climate, and animal activity, the combined effect of which is to foster deflation. The prevailing westerly winds then build sand-dunes along the south-eastern and eastern margins of most pans in the region (De Bruiyn 1971, 1972).

The open plains of the Orange Free State are underlain by typical Karoo sedimentary rocks intruded by dolerites that form rocky hills ('koppies'). Annual precipitation in the Deelpan area is less than 500 mm. The vegetation belongs to the so-called False Upper Karoo (Acocks 1953, veld type 36), comprising grassland with a high proportion of Karoo shrubs, especially Compositae. Woody species such as *Olea africana*, *Rhus lancea*, and *Rhus erosa* occur on dolerite 'koppies'. The pan floor of approximately 6,5 km^2 does not support any vegetation and consists of clays rich in carbonates and other salts concentrated on the surface through evaporation. During most of the year, the pan is dry, except for the south-western portion where perennial springs occur. However, during especially rainy years, water may fill the pan to a depth of 2 m and remain for a year or more. When filled, the pan attracts countless numbers of water-birds. In prehistoric times, it probably also attracted large numbers of antelopes and other animals. Artefacts found along the margins of Deelpan and various other pans in the region point to frequent visits by prehistoric man (Butzer *et al.* 1973; Butzer 1974; Horowitz *et al.* 1978).

CONTEXT OF THE BONE ASSEMBLAGE

As at many western Free State pans, unconsolidated Quaternary deposits at Deelpan occur along its southern and eastern margins. Recent erosion of these deposits has allowed recognition of a three-part sedimentary sequence (from top to bottom): 1, more than 2 m of semi-compacted sands, exhibiting distinct stratification in places; 2, approximately 1 m of semi-compacted, non-stratified sands, especially obvious in the southernmost exposures; and 3, more than 3 m of compact, calcareous clayey sands. The bones described here came from near the bottom of the uppermost unit (1). Only traces of bones were found in the two lower units, along with occasional mollusc shells and fragments of ostrich egg-shell.

Within the uppermost sedimentary unit, bones were found at the same level in two distinct concentrations, labelled A and B, approximately 3 m apart. At point B, a subtle colour difference suggests the bones lie in a pocket roughly 30 cm across within the loose sands. It seems likely that the pocket is the cross-section of an ancient burrow, quite possibly part of a system also including the bone occurrence at A. This hypothesis can be checked only by excavation, which may also lead to the recovery of bones in the sands between A and B. The present bone collection consists totally of pieces that were eroding out of the sections at A and B or had already eroded out and were lying on the pediment below.

Preliminary observations indicate that the sedimentary sequence observed at Deelpan also characterizes the unconsolidated sediments found at most isolated pans in the western Orange Free State. The similarity almost certainly reflects a common response to past climatic change. Horowitz *et al.* (1978) have described an especially similar sequence at Voigtspost Pan, approximately 40 km west of Deelpan. The specific palaeoclimatic events involved at Voigtspost remain to be worked out, but comparison to Deelpan is still informative. Particularly pertinent are ^{14}C determinations of 6350 ±75 B.P. (Pta – 1520) and 1220 ± 50 B.P. (Pta – 1483) on ostrich egg-shell fragments from sediments at Voigtspost equivalent to Deelpan sedimentary units 3 and 1 respectively. The dates indicate that the visible sedimentary sequences at Voigtspost and Deelpan date from the Holocene, while the bone assemblage from Deelpan A and B is probably of late Holocene age.

Limited palynological evidence from Voigtspost suggests that the middle unit (equivalent to unit 2 at Deelpan) was deposited under slightly moister conditions than the underlying and overlying sediments (equivalent to units 3 and 1 at Deelpan). However, the pollen spectra imply basically highveld vegetation throughout the sequence. The pollen from the uppermost sands at Voigtspost, equivalent to the bone-bearing unit at Deelpan, comprises 2% Gramineae, 43% Chenopodiaceae, 11% Compositae, 30% spores of *Riccia* and *Ophioglossum*, and traces of other plants. Pollens were not found in the equivalent Deelpan sediments, but 90% of the pollen found in coprolites accompanying the Deelpan bones derived from Gramineae. The difference probably reflects the differing nature of sediments and coprolites as pollen traps, plus the fact that the pollen in the Voigtspost samples was probably deposited over a relatively long period in the halophytic environment of the pan shore. Like the Voigtspost pollen, that in the Deelpan coprolites almost certainly reflects essentially highveld vegetation.

THE BONE ASSEMBLAGE

Since there is every likelihood that the bones from Deelpan A and B were accumulated at the same time by the same agency, they have been treated here as a single assemblage. The bones are relatively fresh looking, with no apparent mineralization, in keeping with their probable late Holocene age. Fragmentation is minimal and nearly every piece was immediately identifiable to skeletal part and species.

The species represented are listed in Table 1, which also presents the number of bones assigned to each and the minimum number of individuals from which the bones derive. The skeletal parts by which each species is represented are listed in Table 2. The ungulate species present are the classic, historic inhabitants of the highveld, and their occurrence is thus totally in keeping with pollen evidence that highveld vegetation prevailed at the time the

TABLE 1

The number of identifiable bones: the minimum number of individuals by which various species are represented in the bone assemblage from Deelpan A and B.

steenbok (*Raphicerus campestris*)	1/1
springbok (*Antidorcas marsupialis*)	48/3
black wildebeest (*Connochaetes gnou*)	24/4
blesbok (*Damaliscus dorcas*)	11/2
quagga or Burchell's zebra (*Equus quagga* or *E. burchelli*)	1/1
caracal or serval (*Felis caracal* or *F. serval*)	3/1
hyena (Hyaenidae gen. et sp. indet.)	9 coprolites
slender mongoose (*Herpestes sanguineus*)	1/1
clawless otter (*Aonyx capensis*)	2/1
black-backed jackal (*Canis mesomelas*)	6/2
eagle or hawk (Accipitridae gen. et sp. indet.)	2/1

TABLE 2

The number of identifiable bones/the minimum number of individuals per skeletal element per taxon in the fauna from Deelpan A and B.

	steenbok	springbok	wildebeest	blesbok	quagga/ zebra	caracal/ serval	mongoose	otter	jackal	eagle/ hawk
frontlet										
male		2/2								
female		1/1		1/1						
maxilla		3/2		2/1						
mandible		4/2		1/1				2/1	2/2	
atlas		1/1	1/1							
axis		1/1	2/2							
other cervicals		4/1	2/1							
thoracic vertebrae		1/1				2/1				1/1
lumbar vertebrae										
sacral vertebrae										
caudal vertebrae		2/1								
ribs		4/1								
scapula		3/2	1/1							
humerus		2/2	3/3				1/1		1/1	1/1
radius		4/2	3/2	2/2						
ulna		1/1		1/1						
carpals		1/1	1/1							
metacarpals		5/2	4/4	2/2		1/1				
innominate	1/1	1/1	1/1							
femur		1/1								
tibia		3/2	1/1							
patella										
astragalus		1/1	1/1							
calcaneum			1/1							
other tarsals			2/1							
metatarsals		1/1			1/1				1/1	
phalanges		3/1	1/1	1/1						

bones accumulated. The species composition is also totally consistent with a late Holocene age. The complete absence of domestic stock (cattle and/or sheep and goats) further suggests that the bones antedate European settlement of the area, beginning in the middle part of the last century. It is possible that domestic stock were introduced to the area even earlier by indigenous Khoi

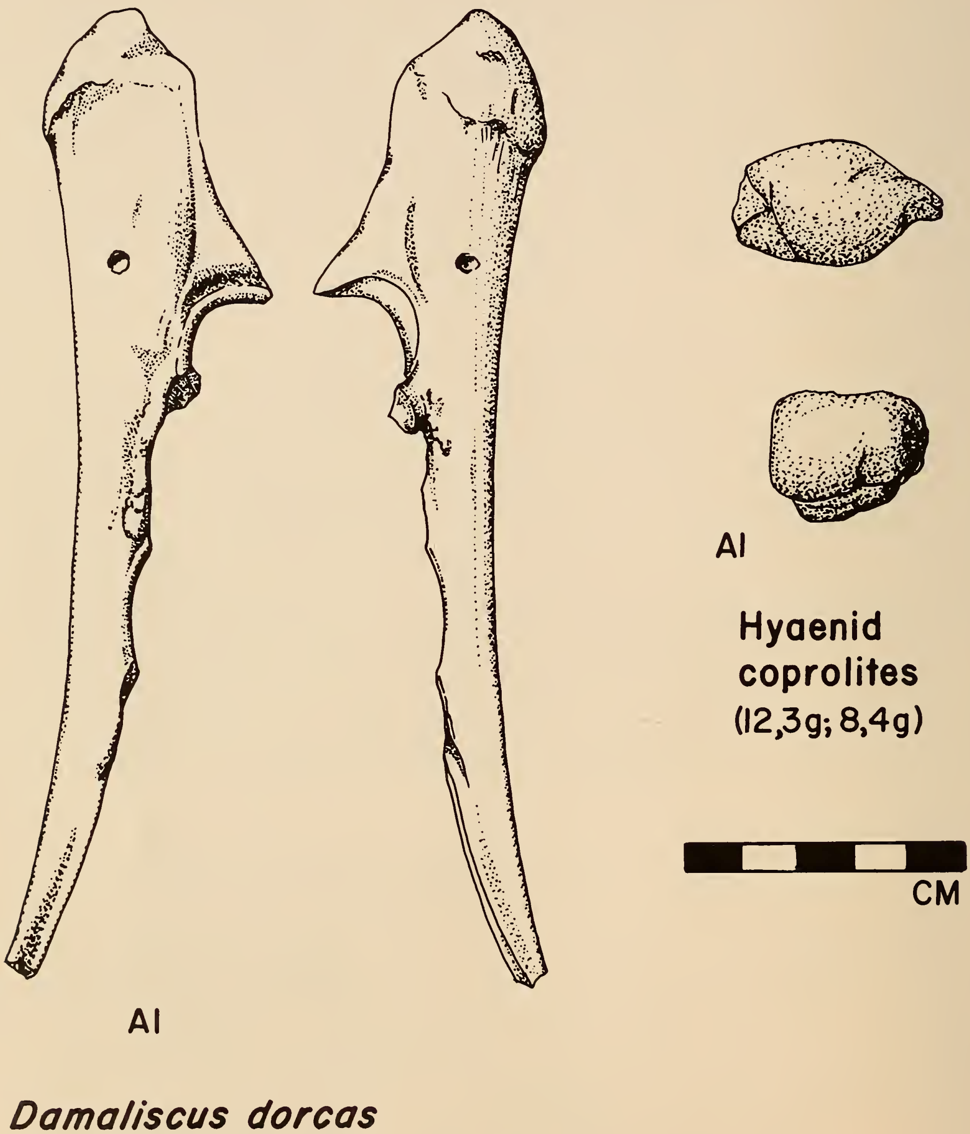

Fig. 2. *Left:* A blesbok ulna from Deelpan A displaying punctate depressions probably caused by the canines of a hyena. *Right:* Hyena coprolites from Deelpan A.

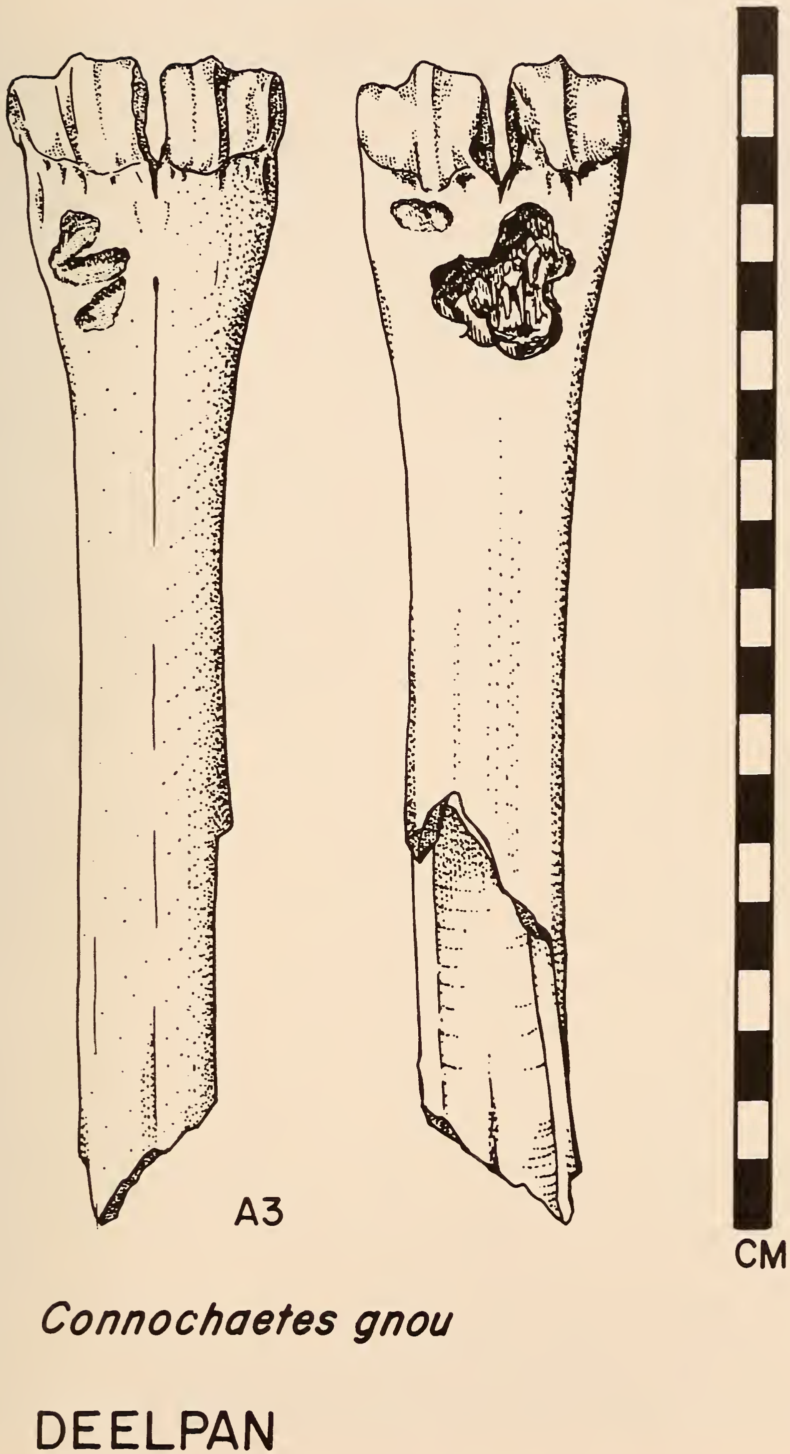

Fig. 3. A black wildebeest distal metacarpal from Deelpan A exhibiting damage to the outer table that was probably caused by hyena chewing.

herders or Iron Age mixed farmers, but Deelpan lies in a relatively dry region where both archaeological and historic records suggest that prehistoric occupation was largely, if not exclusively limited to hunter–gatherers (Maggs 1976).

In southern Africa, there are three potential accumulators of bones at a site such as Deelpan. Two—people and porcupines (*Hystrix africaeaustralis*)—are ruled out by the absence of their telltale signs—artefacts and gnaw marks respectively. The third—hyenas—are clearly indicated by the presence of their coprolites (9 in total) and of two ungulate bones with what are almost certainly damage marks from carnivore teeth (Figs 2–3).

Both the brown hyena (*Hyaena brunnea*) and the spotted hyena (*Crocuta crocuta*) occurred in the region of Deelpan historically, and both are known to accumulate bones in dens or lairs, including abandoned aardvark burrows or other subterranean cavities of sufficient size. It is such burrows, now filled in or collapsed, that may well be represented at Deelpan. The brown form is the more prodigious bone collector of the two, largely because it brings food back to its young, while the spotted form does not. The two species also differ in the kinds of animals that they most frequently eat. The brown hyena feeds much more often on species springbok-size and smaller, reflecting its general incompetence as a hunter and its inability to retain the carcasses of larger animals when other large predators–scavengers are also present. (See Sutcliffe (1970), Kruuk (1972), Bearder (1977), Mills (1978*a*), Mills & Mills (1977), and Henschel *et al.* (1979) for information on the spotted hyena; Mills (1973, 1978*b*), Mills & Mills (1977), Skinner (1976), and Owens & Owens (1978, 1979) for data on the brown hyena.)

Tables 1 and 2 show that springbok is the most common species at Deelpan in terms of the number of identifiable bones, while black wildebeest is most common in terms of the minimum number of individuals represented. In combination with the fact that the relative abundance of these species in the ancient Deelpan environment remains unknown and perhaps unknowable, this means that the species frequencies in the present sample do not help to establish which hyena accumulated the bones. Perhaps ultimately this question will be resolved, if it becomes possible to identify the coprolites to species.

Whichever hyena is responsible, the Deelpan assemblage contrasts with hominid (archaeological) bone assemblages in two important respects:

1. The relative abundance of carnivores. In minimum individual terms, carnivores constitute 31% of the animals in the Deelpan sample, while there is no archaeological sample in Africa in which the comparable figure has been found to exceed 13%. The contrast probably reflects the fact that hyenas (especially the brown species) interact with other carnivores (especially jackals) much more frequently than hunter–gatherers do.

2. At Deelpan, there is a clear tendency for larger species to be relatively better represented by postcranial bones than by cranial ones. In archaeological assemblages, there is no such trend, and the cranial:postcranial ratio does not seem to be related to the size of the species concerned. The contrast probably

reflects the fact that hyenas find it far more difficult to transport the skulls of large animals than people do, while both kinds of bone accumulators find postcranial bones about equally portable.

Klein has found that the same features characterize fossil bone assemblages collected by hyenas at other sites in southern Africa, particularly Swartklip 1 (Hendey & Hendey 1968; Klein 1975), Equus Cave (Beaumont & Shackley pers. comm.; Klein in preparation), and the Elandsfontein 'Bone Circle' (Inskeep & Hendey 1966; Klein unpub.). These other samples are all much larger than the Deelpan one, and the fact that the features are still clear at Deelpan is thus a measure of the strength of the pattern they represent.

One feature that might be expected to characterize hyena accumulations would be a large number of bones obviously damaged by the animals' teeth. In fact, such bones are relatively rare not only at Deelpan but also in the other fossil assemblages mentioned above and apparently in assemblages from dens where living hyenas were observed, though precise figures on damaged bones from such dens are generally lacking. (The bones found at active dens are discussed in some of the papers on hyena feeding and foraging cited above.) The implication of this is that, where there is doubt as to the human or hyenid origin of a particular bone assemblage, principal reliance will probably have to be placed on relatively subtle features such as the abundance of carnivores or the nature of the relationship between species size and cranial:postcranial bone representation.

In southern Africa, the most important bone assemblages whose origins remain problematic are certainly those from the various australopithecine caves in the Transvaal. The question is basically whether the bones were brought to the caves by the australopithecines, as argued particularly by Dart (1957*a*, 1957*b*) or perhaps by a carnivore, as discussed particularly by Brain (1980, 1981). *A priori*, in considering the possibility that hyenas were involved, it might seem most reasonable to attack the problem by analysing bones from recent hyena dens. However, the samples from such dens tend to be very small, while the dens themselves are mostly in marginal or degraded environments. Often, many of the bones present come from domesticated species. Furthermore, especially in the case of the brown hyena, which has become comparatively rare, it is unlikely that there are very many dens left to be sampled. All this means that the study of the fossil collections is essential both to establish a convincing pattern of differences between hyena and hominid assemblages and to maintain reasonable control over environmental and ecological variables in exploring the origins of assemblages such as those from the australopithecine caves.

Klein (1975) has already argued that there are marked similarities between the bone assemblage from Swartklip (and by extension from Deelpan and other hyena-accumulated samples) on the one hand and the bone assemblage from Makapansgat on the other, as partially described by Dart (1957*a*, 1957*b*) and Wells & Cooke (1956). Some fresh data on the Makapansgat carnivores